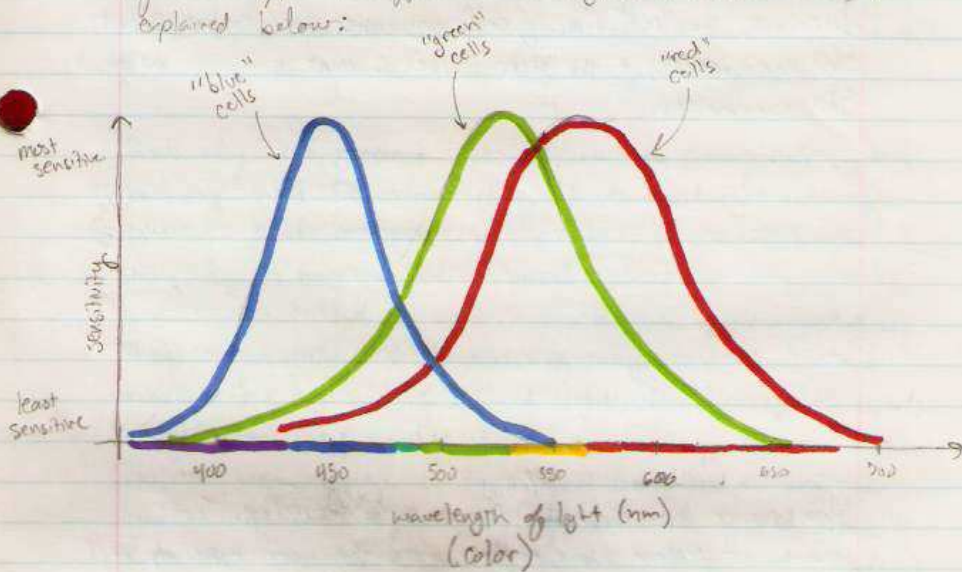


Subtractive Colors

Red - Yellow - Blue Primary Colors.

Human vision is called trichromatic, meaning it can see 3 colors, sort of. What it really means is that there are 3 different types of light-sensitive cells in the back of the eye. Each of these different types is most sensitive to a different wavelength (color) of light. These different types are usually called red, green, & blue which [very] approximately indicates the color they are most sensitive to. A graph of the sensitivity of each type to different wavelengths is shown here, & explained below:



The horizontal axis shows different wavelengths of light. The color of light is dependent on its wavelength, as shown by the rainbow drawn on the line. For instance, light with 450 nanometer wavelength is blue, & 550 nanometer light is yellow.

On the graph, each of the 3 different types of eye cells has a different curve, in a different color. The height of the curve at each wavelength indicates how sensitive that type of cell is to that wavelength of light. So for instance, the "blue" type of cell is most sensitive (has its peak in the curve) at about 440 nanometers, which is blue (slightly purple). However, it is also sensitive to a range of other wavelengths between a bit less than 400 nanometers + 550 nanometers, its just not as sensitive as it is to 440 nanometer light.

Likewise, the "red" type of cells are most sensitive at about 560 nanometers, + the "green" type is most sensitive at about 530 nanometers.



You notice how the different curves overlap. That means at certain wavelengths, more than one type of cell is sensitive. Take yellow light for instance. You can see on the graph at about 580 nanometers, the "red" + "green" type of cell both have about the same sensitivity, but the "blue" type has almost no sensitivity. What that means is that when yellow light reaches your eye, the "red" + "green" types of cells both send

signals to the brain, & since they both have about the same sensitivity to this wavelength of light (yellow), the strength of the signals is about the same from each type of cell. Since the "blue" type of cell has almost no sensitivity to this color of light, it will send a very weak signal (if any) to the brain. It's this combination of signals from the different types of cells that tell the brain that the light is yellow.

Looking back at the graph, you can see that as you start sliding towards orange (towards the right from yellow), the "green" cells' sensitivity drops, & the "red" cells' increases slightly. That means it will be a different pattern of signals going to the brain: strong from "red" cells, a little weaker from "green" cells, & none from "blue" cells. This combination of signals indicates orange to the brain.

That's why red, green, & blue are used as primary colors when combining lights. For instance, if you have a red light and a green light of equal brightness (no blue light), then it will trigger strong signals from the "red" & "green" cells, & none from the blue, so it will look the same to your brain as yellow light does. Then, if you decrease the brightness of the green light a little & increase the brightness of the red light, it will change the signals in the same way so that it looks orange to your brain.

In this way, you can "trick" your brain into thinking the light is any color by combining different levels of red, green, & blue light in order to trigger the same pattern of signals from the three types of cells as actual light of that color would.

Combining colors of light is called additive color blending because you're adding different wavelengths of light together to make

different colors. However, when you mix opaque things, like paint, it is called subtractive color blending, because each color removes certain wavelengths of light.

For instance, red paint absorbs all wavelengths of light except those around 600 nanometers (red light), which is reflected back, & that's why it looks red.

For yellow paint to look yellow, the light that reflects off of it must trigger the same sensitivity in both the "red" & "green" types of cells, but minimal or no sensitivity in the "blue" type. In other words, yellow paint looks yellow because it absorbs light with small wavelengths (blue & purple), & reflects the rest.

Blue paint, on the other hand, looks blue because it only reflects wavelengths that the "blue" cells are sensitive to while absorbing light that the "red" cells are sensitive to.

So if you mix yellow paint & blue paint, the yellow paint will block (absorb) the wavelengths that the "blue" cells are sensitive to, & the blue paint will block the wavelengths that the "red" cells are sensitive to. The only remaining wavelengths (that are not absorbed but are instead reflected back at the eye) are those that the "green" cells are sensitive to, hence yellow & blue paint mixed together look green.